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PATENT APPLICATION
Docket No. 17653.31A.2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND
INTERFERENCES

In re application of:		)	
		)	
	Sergei Turitsyn, et al.	)	
		)	
Serial No.:	10/553,338	)	
		)	
Filed:	October 14, 2005	)	Art Unit
		)	2613
For:	DATA FORMAT FOR HIGH BIT RATE WDM TRANSMISSION	)	
		)	
		)	
Examiner:	Agustin Bello	)	
		)	
Customer No.:	22913	)	

BRIEF FOR APPELLANT

VIA eFILE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

On December 17, 2009, Appellant timely filed a Notice of Appeal from the action of the Examiner in finally rejecting all of the pending claims in this application. This appeal brief relates to the Notice of Appeal and is being filed under the provisions of 37 C.F.R. § 41.37. A Request for Pre-Appeal Brief Conference was filed concurrently with the Notice of Appeal. On January 28, 2010, the Notice of Panel Decision was mailed. The Notice extended the original period for filing the Appeal Brief until February 28, 2010. The filing fee of $270.00, as set forth

in 37 C.F.R. § 41.20(b)(2), is submitted herewith, along with a petition and fee for a three month extension of time, extending the period for response until May 28, 2010.

REAL PARTY IN INTEREST

The real party in interest is Xtera Communications, Ltd., which is a subsidiary of Xtera Communications, Inc. Azea Networks, Ltd., the recorded assignee, recently changed its name to Xtera Communications, Ltd.

RELATED APPEALS AND INTERFERENCES

There are no related appeals and interferences.

STATUS OF CLAIMS

The application was originally filed with claims 1-9. Subsequent to filing, claim 2, 4, 8 and 9 have been cancelled and new Claims 10-24 have been added. Claims 1, 3, 5-7 and 10-24 remain pending. Claims 1, 3, 6, 7, 14, 15, 19 and 20 have been amended. Claims 1, 3, 5-7 and 10-24 now stand rejected by the Examiner. All pending claims (Claims 1, 3, 5-7 and 10-24) are now being appealed.

STATUS OF AMENDMENTS

An amendment dated May 8, 2009 was submitted and has been entered by the Examiner.

SUMMARY OF CLAIMED SUBJECT MATTER

The appealed claims are directed to the optical encoding of data for transmission over a wavelength division multiplexed optical communication system. There are three independent claims: claims 1, 6 and 19. Claim 1 presents the invention in the form of a method of optical encoding, whereas claims 6 and 19 present the invention in the form of a transmitter that performs the optical encoding.

I. Claim 1.

The subject matter of claim 1 will first be described:

Claim 1 reads as follows:

1. A method of optically encoding data for transmission over a wavelength division multiplexed optical communications system comprising the steps of:

generating a periodic series of optical pulses defining a series of time slots, wherein one pulse appears in each time slot;

filtering the pulses by way of a filter to produce carrier pulses extending over more than one time slot; and

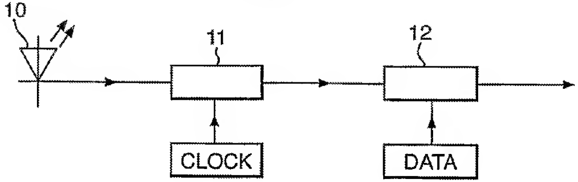
modulating the pulses with data for transmission; wherein

for each of at least some of the carrier pulses, the filter gives rise to the corresponding carrier pulse having a temporal profile with a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse, the temporal profile of the corresponding carrier pulse further having an oscillating tail that extends from the minimum into at least one time slot that is even further from the time slot for the corresponding carrier pulse.

In claim 1, there is recited "[a] method of optically encoding data for transmission over a wavelength division multiplexed optical communications system." In optical communication systems, data is transmitted optically over a channel that is capable of conveying optical information. An example of such a channel is an optical fiber. In wavelength division multiplexed (WDM) optical communication fiber systems, the fiber capacity is increased by transmitting multiple channels over a single fiber, each channel corresponding to a different wavelength of light. (*E.g.*, Specification at Page 1, lines 14-15).

When optical data is transmitted over each channel, the data is first encoded. Figure 1 (reproduced below) illustrates an example of a prior art transmitter that may be used to encode optical data for an optical channel:

Fig.1.



Coherent light source 10, which may be a continuous wave laser, produces an optical beam which is first modulated with an electrical clock signal using a first modulator 11, which provides a series of pulses at a particular bit rate defined by the clock. (*E.g.*, Specification at Page 3, lines 14-16 and 19-20). The signal is then modulated with a data signal using a second modulator 12, which puts data onto the series of pulses by modulating them with Non-Return-to-Zero (NRZ) electrical data. (*E.g.*, Specification at Page 3, lines 14-17 and 20-21). The resulting output is an optical signal that is encoded with data using the Return-to-Zero (RZ) format.

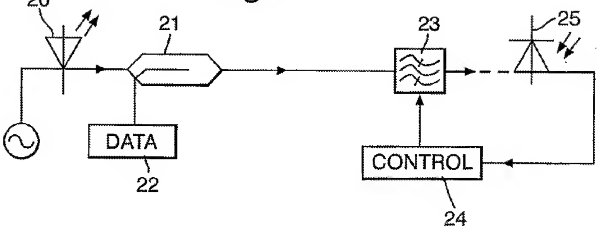
Each RZ pulse has an associated profile in the time domain (often called is "temporal profile") and in the frequency domain (often called the "spectral profile"). As the concepts of time domain and frequency domain have been confused in the prosecution history, this summary will briefly set forth the relationships and distinctions of each. In the time domain, the temporal profile of a signal plots <u>time</u> on the horizontal axis, and optical strength on the vertical axis. In

the frequency domain, the spectral profile plots frequency on the horizontal axis, and optical strength on the vertical axis. Thus, the temporal profile of an optical signal may appear much different than the frequency profile of the same optical signal. When determining the nature of an optical signal described by a reference, it is thus critical to note whether the described or illustrated optical signal is being represented by a temporal profile or a spectral profile. Confusing the two can lead to unjustified conclusions regarding what kind of optical signal a reference is describing.

As an example, the shorter an RZ pulse (i.e., the shorter the temporal profile) emitting from the modulator 12, the broader the spectral profile. The longer the RZ pulse emitting from the modulator 12, the shorter the spectral profile. Note that the temporal profile and spectral profile of a pulse thus seem to have opposite effect all things being equal. Shorter pulses in the time domain result in wider profiles in the frequency domain, and vice versa. Pulses that are emitted at higher bit rates will tend to result in broader spectral profiles. (*E.g.*, Specification at Page 3, lines 27-31). In WDM transmission systems, each wavelength channel must be spaced from adjacent wavelength channel in order to avoid excessive inter-channel crosstalk and other corrupting mechanisms. (*E.g.*, Specification at Page 3, lines 25-27). However, the narrower the spectrum of the pulse, the broader the pulse in the time domain, which could potentially lead to overlapping with neighboring pulses in the time domain, resulting in patterning effects.

Figure 2 (reproduced below) illustrates an example of a transmitter that may generate such a series of pulses in accordance with embodiments of the invention:

Fig.2.



The transmitter generates optical signals with a narrow spectral width while avoiding strong patterning effects. (*E.g.*, Specification at Page 3, line 33 through Page 4, line 2).

Returning to the language of claim 1, the encoding is performed by "generating a periodic series of optical pulses defining a series of time slots, wherein one pulse appears in each time slot". The active mode lock laser 12 generates such a series of narrow pulses at a particular bit rate. (*E.g.*, Specification at Page 4, line 3-5).

Claim 1 also recites "modulating the pulses with data for transmission". Referring to Figure 2, electrical NRZ data is written onto the pulsed light stream using an electro-optic modulator 21 that is driven by an electrical NRZ data source 22 operated at the same bit rate as the light source 20. (*E.g.*, Specification at Page 4, lines 9-12).

Pulses from the light source 20, and the modulator 21, are extremely narrow in the time domain (i.e., they have a narrow temporal profile) and thus have a broad spectral profile. Claim 1 recites a unique filtering involving "filtering the pulses by way of a filter to produce carrier pulses extending over more than one time slot". Referring to Figure 2, the filtering may be performed by the filter element 23. (*E.g.*, Specification at Page 4, lines 13-18).

Specifically, claim 1 recites that for each of at least some of the carrier pulses, "the filter gives rise to the corresponding carrier pulse having a temporal profile with a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse, the temporal profile of the corresponding carrier pulse further having an oscillating tail that extends from the minimum into at least one time slot that is even further from the time slot for the corresponding carrier pulse" (emphasis added). Figure 3A (reproduced below) illustrates the spectral profile of an optical signal before filtering by filter 23:

Fig.3a.

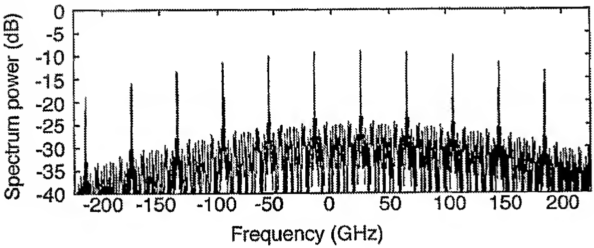
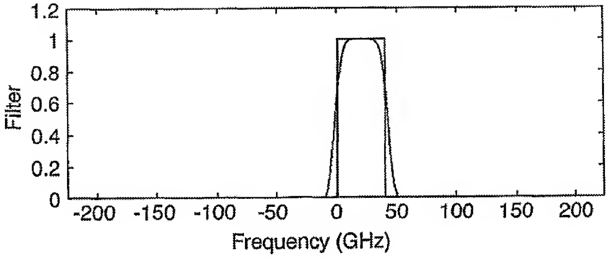


Figure 3b (reproduced below) illustrates the frequency response of the filter 23 of Figure 2:

Fig.3b.



A rectangle is provided to show an ideal frequency response of a filter having a flat top and a vertical cut-off on both ends. The curve is the actual filter response. (*E.g.*, Specification at Page 4, lines 22-24).

Figure 3c (reproduced below) illustrates the <u>spectral</u> profile of an optical signal after filtering using the filter 23:

Fig.3c.

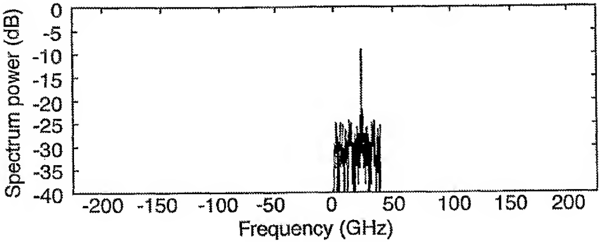
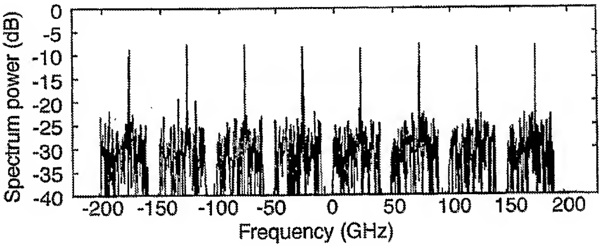


Figure 3d (reproduced below) illustrates the spectral profile for a series of WDM channels filtered using the filter 23 and having a channel spacing of 50 GHz, a spectral width of 40 GHz, and a separation between spectral widths of 10 Ghz.

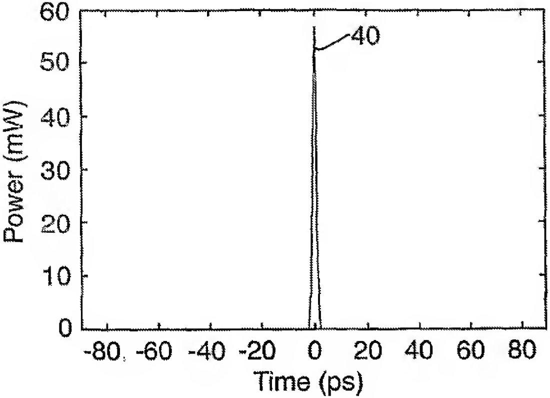
Fig.3d.



Note that each of Figures 3a through 3d represent spectral profiles, not temporal profiles. Figures 4a and 4b represent temporal profiles of the signal before and after filtering.

Figure 4a (reproduced below) illustrates the temporal profile of the signal before filtering as follows:

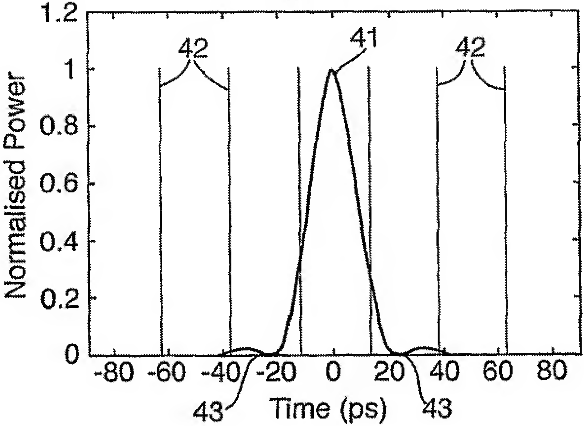
Fig.4a.



Note that the temporal profile of Figure 4a represents the same optical signal as the spectral profile of Figure 3a, despite their dramatic difference in appearance. If temporal and spectral profiles are interpreted to be the same (as appears to have been done in the prosecution history), one would arrive at a completely erroneous understanding of the core nature of the optical signal prior to filtering.

Figure 4b (reproduced below) illustrates the temporal profile of the signal after filtering as follows:

Fig.4b.



Once again, note that the temporal profile of Figure 4b represents the same optical signal as the spectral profile of Figure 3c, despite their dramatic difference in appearance. If temporal and spectral profiles are interpreted to be the same, one would arrive at a completely erroneous understanding of the core nature of the optical signal after filtering.

Once again, referring to Figure 4b, claim 1 recites that for each of at least some of the carrier pulses, "the filter gives rise to the corresponding carrier pulse having a temporal profile with a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse, the temporal profile of the corresponding carrier pulse further having an oscillating tail that extends from the minimum into at least one time slot that is even further from the time slot for the corresponding carrier pulse" (emphasis added).

In Figure 4b, the vertical lines show when each time slot begins and ends relative to the pulse shown. (*E.g.*, Specification at Page 4, lines 33-34). In the illustrated case, in which the bit rate is 40 GHz, each time slot lasts 25 picoseconds (note: one picosecond is equal to 10^{-12} seconds). (*E.g.*, Specification at Page 4, lines 34 to Page 5, line 1). The pulse 41 extends over several time slots and the minima 43 of the filtered pulse falls in the center of the time slots adjacent to the time slop the pulse is centered on. (*E.g.*, Specification at Page 5, lines 1-4). The result is that the effect of the temporal overlap with neighboring bits or pulses is reduced. (*E.g.*, Specification at Page 5, lines 4-5).

The transmitter produces a signal with a narrow spectral width in which the pulse in the time domain overlaps several time slots without significantly adversely impacting neighboring pulses. Thus, narrow spectral pulses are achieved without significant patterning effects in the time domain.

II. <u>Claim 6.</u>

Whereas claim 1 recites a method of encoding an optical signal, claim 6 recites a transmitter that performs the optical encoding. Claim 6 reads as follows:

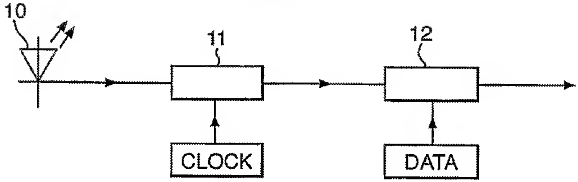
> 6. A transmitter for producing an optical data signal for transmission over a wavelength division multiplexer optical communication system comprising:
>
> means for producing a periodic series of optical pulses defining a series of time slots, wherein one pulse appears in each time slot;
>
> a filter having a spectral profile giving rise to carrier pulses, each carrier pulse having a temporal profile extending over more than one time slot, the temporal profile having a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse, the temporal profile of the corresponding carrier pulse further having an oscillating tail that extends from the minimum into at least one time slot that is even further from the time slot for the corresponding carrier pulse; and
>
> modulating means for modulating the pulses with data for transmission.

In claim 6, there is recited "[a] transmitter for producing an optical data signal for transmission over a wavelength division multiplexed optical communication system." In optical

communication systems, data is transmitted optically over a channel that is capable of conveying optical information. An example of such a channel is an optical fiber. In wavelength division multiplexed (WDM) optical communication fiber systems, the fiber capacity is increased by transmitting multiple channels over a single fiber, each channel corresponding to a different wavelength of light. (*E.g.*, Specification at Page 1, lines 14-15).

When optical data is transmitted over each channel, the data is first encoded. Figure 1 (reproduced below) illustrates an example of a prior art transmitter that may be used to encode optical data for an optical channel:

Fig.1.

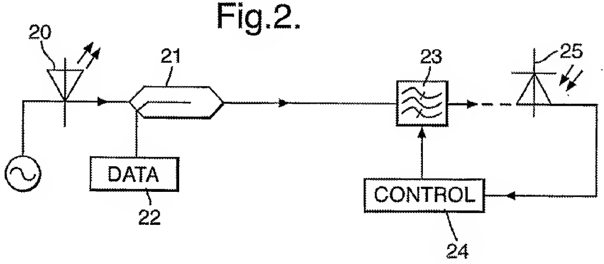


Coherent light source 10, which may be a continuous wave laser, produces an optical beam which is first modulated with an electrical clock signal using a first modulator 11, which provides a series of pulses at a particular bit rate defined by the clock. (*E.g.*, Specification at Page 3, lines 14-16 and 19-20). The signal is then modulated with a data signal using a second modulator 12, which puts data onto the series of pulses by modulating them with Non-Return-to-Zero (NRZ) electrical data. (*E.g.*, Specification at Page 3, lines 14-17 and 20-21). The resulting output is an optical signal that is encoded with data using the Return-to-Zero (RZ) format.

Each RZ pulse has an associated profile in the time domain (often called is "temporal profile") and in the frequency domain (often called the "spectral profile"). As the concepts of time domain and frequency domain have been confused in the prosecution history, this summary will briefly set forth the relationships and distinctions of each. In the time domain, the temporal profile of a signal plots <u>time</u> on the horizontal axis, and optical strength on the vertical axis. In the frequency domain, the spectral profile plots <u>frequency</u> on the horizontal axis, and optical strength on the vertical axis. Thus, the temporal profile of an optical signal may appear much different than the frequency profile of the same optical signal. When determining the nature of an optical signal described by a reference, it is thus critical to note whether the described or illustrated optical signal is being represented by a temporal profile or a spectral profile. Confusing the two can lead to unjustified conclusions regarding a reference.

As an example, the shorter an RZ pulse emitting from the modulator 12, the broader the spectral profile. The longer the RZ pulse emitting from the modulator 12, the shorter the spectral profile. Note that the temporal profile and spectral profile of a pulse thus seem to have opposite effect all things being equal. Shorter pulses in the time domain result in wider profiles in the frequency domain, and vice versa. Pulses that are emitted at higher bit rates will tend to result in broader spectral profiles. (*E.g.*, Specification at Page 3, lines 27-31). In WDM transmission systems, each wavelength channel must be spaced from adjacent wavelength channel in order to avoid excessive inter-channel crosstalk and other corrupting mechanisms. (*E.g.*, Specification at Page 3, lines 25-27). However, the narrower the spectrum of the pulse, the broader the pulse in the time domain, which could potentially lead to overlapping with neighboring pulses in the time domain, resulting in patterning effects.

Figure 2 (reproduced below) illustrates an example of a transmitter that may generate such a series of pulses in accordance with embodiments of the invention:



The transmitter generates optical signals with a narrow spectral width while avoiding strong patterning effects. (*E.g.*, Specification at Page 3, line 33 through Page 4, line 2).

Returning to the language of claim 6, the transmitter includes "means for producing a periodic series of optical pulses defining a series of time slots, wherein one pulse appears in each time slot". The active mode lock laser 12 generates such a series of narrow pulses at a particular bit rate. (*E.g.*, Specification at Page 4, line 3-5).

Claim 6 also recites "modulating means for modulating the pulses with data for transmission". Referring to Figure 2, electrical NRZ data is written onto the pulsed light stream using an electro-optic modulator 21 that is driven by an electrical NRZ data source 22 operated at the same bit rate as the light source 20. (*E.g.*, Specification at Page 4, lines 9-12).

Pulses from the light source 20, and the modulator 21, are extremely narrow in the time domain (i.e., they have a narrow temporal profile) and thus have a broad spectral profile. Claim 6 recites that the transmitter includes "a filter having a spectral profile giving rise to carrier

pulses, each carrier pulse having a temporal profile extending over more than one time slot". Referring to Figure 2, the filtering may be performed by the filter element 23. (*E.g.*, Specification at Page 4, lines 13-18).

Specifically, claim 6 recites that "the <u>temporal</u> profile [has] a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse, the temporal profile of the corresponding carrier pulse further having an oscillating tail that extends from the minimum into at least one time slot that is even further from the time slot for the corresponding carrier pulse." Figure 3A (reproduced below) illustrates the <u>spectral</u> profile of an optical signal before filtering by filter 23:

Fig.3a.

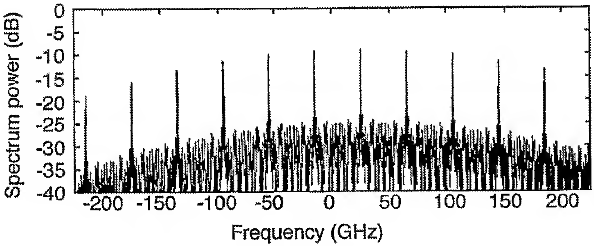
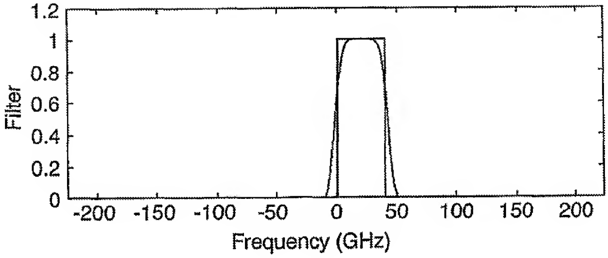


Figure 3b (reproduced below) illustrates the frequency response of the filter 23 of Figure 2:

Fig.3b.



A rectangle is provided to show an ideal frequency response of a filter having a flat top and a vertical cut-off on both ends. The curve is the actual filter response. (*E.g.*, Specification at Page 4, lines 22-24).

Figure 3c (reproduced below) illustrates the <u>spectral</u> profile of an optical signal after filter using the filter 23:

Fig.3c.

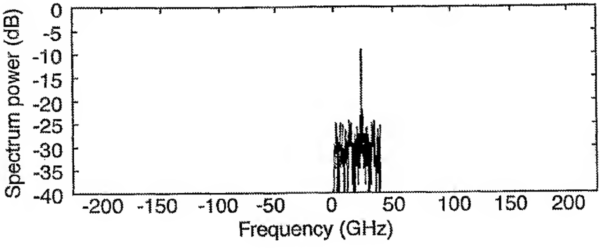
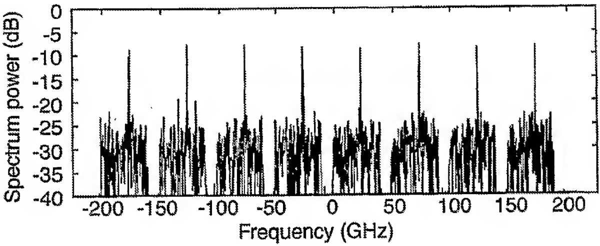


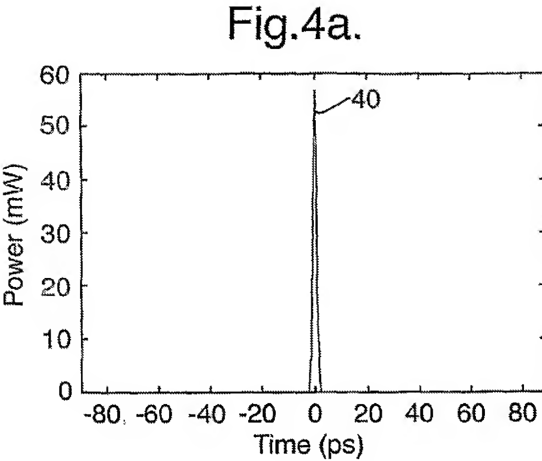
Figure 3d (reproduced below) illustrates the <u>spectral</u> profile for a series of WDM channels filtered using the filter 23 and having a channel spacing of 50 GHz, a spectral width of 40 GHz, and a separation between spectral widths of 10 Ghz.

Fig.3d.



Note that each of Figures 3a through 3d represent spectral profiles, not temporal profiles. Figures 4a and 4b represent temporal profiles of the signal before and after filtering.

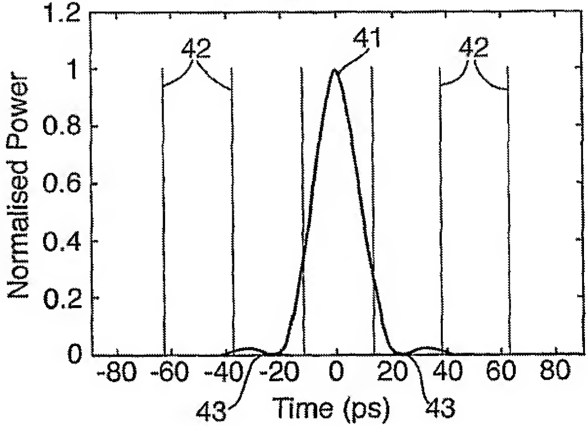
Figure 4a (reproduced below) illustrates the temporal profile of the signal before filtering as follows:



Note that the temporal profile of Figure 4a represents the same optical signal as the spectral profile of Figure 3a, despite their dramatic difference in appearance. If temporal and spectral profiles are interpreted to be the same, one would arrive at a completely erroneous understanding of the core nature of the optical signal prior to filtering.

Figure 4b (reproduced below) illustrates the temporal profile of the signal after filtering as follows:

Fig.4b.



Once again, note that the temporal profile of Figure 4b represents the same optical signal as the spectral profile of Figure 3c, despite their dramatic difference in appearance. If temporal and spectral profiles are interpreted to be the same, one would arrive at a completely erroneous understanding of the core nature of the optical signal after filtering.

Once again, referring to Figure 4b, claim 6 recites that for each of at least some of the carrier pulses, "the filter gives rise to the corresponding carrier pulse having a temporal profile with a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse, the temporal profile of the corresponding carrier pulse further having an oscillating tail that extends from the minimum into at least one time slot that is even further from the time slot for the corresponding carrier pulse" (emphasis added).

In Figure 4b, the vertical lines show when each time slot begins and ends relative to the pulse shown. (*E.g.*, Specification at Page 4, lines 33-34). In the illustrated case, in which the bit rate is 40 GHz, each time slot lasts 25 picoseconds (note: one picosecond is equal to 10^{-12} seconds). (*E.g.*, Specification at Page 4, lines 34 to Page 5, line 1). The pulse 41 extends over several time slots and the minima 43 of the filtered pulse falls in the center of the time slots adjacent to the time slop the pulse is centered on. (*E.g.*, Specification at Page 5, lines 1-4). The result is that the effect of the temporal overlap with neighboring bits or pulses is reduced. (*E.g.*, Specification at Page 5, lines 4-5).

The transmitter produces a signal with a narrow spectral width in which the pulse in the time domain overlaps several time slots without significantly adversely impacting neighboring pulses. Thus, narrow spectral pulses are achieved without significant patterning effects in the time domain.

III. <u>Claim 19.</u>

Claim 19 reads as follows:

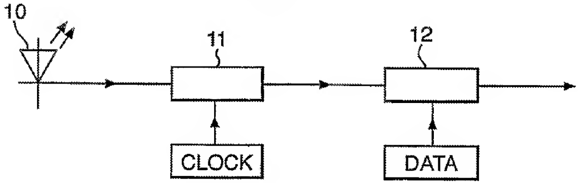
> 19. (Previously Presented) A transmitter for producing an optical data signal for transmission over a wavelength division multiplexer optical communication system comprising:
>
> means for producing a periodic series of optical pulses defining a series of time slots, wherein one pulse appears in each time slot;
>
> a filter having a spectral profile giving rise to carrier pulses, each carrier pulse having a substantially Sinc shaped temporal profile extending over more than one time slot, the substantially Sinc shaped temporal profile having a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse; and
>
> modulating means for modulating the pulses with data for transmission.

In claim 19, there is recited "[a] transmitter for producing an optical data signal for transmission over a wavelength division multiplexed optical communication system." In optical communication systems, data is transmitted optically over a channel that is capable of conveying

optical information. An example of such a channel is an optical fiber. In wavelength division multiplexed (WDM) optical communication fiber systems, the fiber capacity is increased by transmitting multiple channels over a single fiber, each channel corresponding to a different wavelength of light. (*E.g.*, Specification at Page 1, lines 14-15).

When optical data is transmitted over each channel, the data is first encoded. Figure 1 (reproduced below) illustrates an example of a prior art transmitter that may be used to encode optical data for an optical channel:

Fig.1.



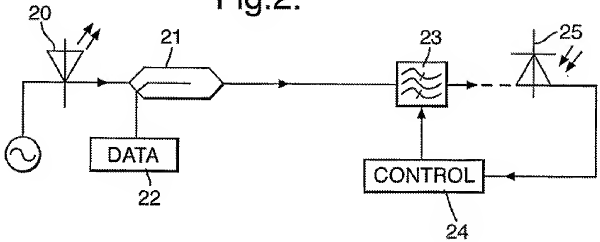
Coherent light source 10, which may be a continuous wave laser, produces an optical beam which is first modulated with an electrical clock signal using a first modulator 11, which provides a series of pulses at a particular bit rate defined by the clock. (*E.g.*, Specification at Page 3, lines 14-16 and 19-20). The signal is then modulated with a data signal using a second modulator 12, which puts data onto the series of pulses by modulating them with Non-Return-to-Zero (NRZ) electrical data. (*E.g.*, Specification at Page 3, lines 14-17 and 20-21). The resulting output is an optical signal that is encoded with data using the Return-to-Zero (RZ) format.

Each RZ pulse has an associated profile in the time domain (often called is "temporal profile") and in the frequency domain (often called the "spectral profile"). As the concepts of time domain and frequency domain have been confused in the prosecution history, this summary will briefly set forth the relationships and distinctions of each. In the time domain, the temporal profile of a signal plots time on the horizontal axis, and optical strength on the vertical axis. In the frequency domain, the spectral profile plots frequency on the horizontal axis, and optical strength on the vertical axis. Thus, the temporal profile of an optical signal may appear much different than the frequency profile of the same optical signal. When determining the nature of an optical signal described by a reference, it is thus critical to note whether the described or illustrated optical signal is being represented by a temporal profile or a spectral profile. Confusing the two can lead to unjustified conclusions regarding a reference.

As an example, the shorter an RZ pulse emitting from the modulator 12, the broader the spectral profile. The longer the RZ pulse emitting from the modulator 12, the shorter the spectral profile. Note that the temporal profile and spectral profile of a pulse thus seem to have opposite effect all things being equal. Shorter pulses in the time domain result in wider profiles in the frequency domain, and vice versa. Pulses that are emitted at higher bit rates will tend to result in broader spectral profiles. (*E.g.*, Specification at Page 3, lines 27-31). In WDM transmission systems, each wavelength channel must be spaced from adjacent wavelength channel in order to avoid excessive inter-channel crosstalk and other corrupting mechanisms. (*E.g.*, Specification at Page 3, lines 25-27). However, the narrower the spectrum of the pulse, the broader the pulse in the time domain, which could potentially lead to overlapping with neighboring pulses in the time domain, resulting in patterning effects.

Figure 2 (reproduced below) illustrates an example of a transmitter that may generate such a series of pulses in accordance with embodiments of the invention:

Fig.2.



The transmitter generates optical signals with a narrow spectral width while avoiding strong patterning effects. (*E.g.*, Specification at Page 3, line 33 through Page 4, line 2).

Returning to the language of claim 19, the transmitter includes "means for producing a periodic series of optical pulses defining a series of time slots, wherein one pulse appears in each time slot". The active mode lock laser 12 generates such a series of narrow pulses at a particular bit rate. (*E.g.*, Specification at Page 4, line 3-5).

Claim 19 also recites "modulating means for modulating the pulses with data for transmission". Referring to Figure 2, electrical NRZ data is written onto the pulsed light stream using an electro-optic modulator 21 that is driven by an electrical NRZ data source 22 operated at the same bit rate as the light source 20. (*E.g.*, Specification at Page 4, lines 9-12).

Pulses from the light source 20, and the modulator 21, are extremely narrow in the time domain (i.e., have a narrow temporal profile) and thus have a broad spectral profile. Claim 19 recites that the transmitter includes "a filter having a spectral profile giving rise to carrier

pulses". Referring to Figure 2, the filtering may be performed by the filter element 23. (*E.g.*, Specification at Page 4, lines 13-18).

Specifically, claim 19 recites that "each carrier pulse having a substantially Sinc shaped temporal profile extending over more than one time slot, the substantially Sinc shaped temporal profile having a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse." Figure 3a (reproduced below) illustrates the spectral profile of an optical signal before filtering by filter 23:

Fig.3a.

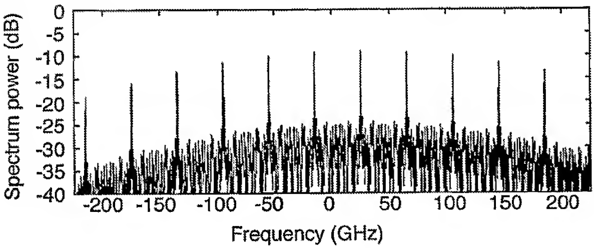
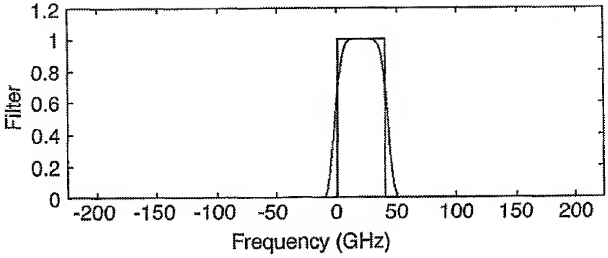


Figure 3b (reproduced below) illustrates the frequency response of the filter 23 of Figure 2:

Fig.3b.



A rectangle is provided to show an ideal frequency response of a filter having a flat top and a vertical cut-off on both ends. The curve is the actual filter response. (*E.g.*, Specification at Page 4, lines 22-24).

Figure 3c (reproduced below) illustrates the <u>spectral</u> profile of an optical signal after filter using the filter 23:

Fig.3c.

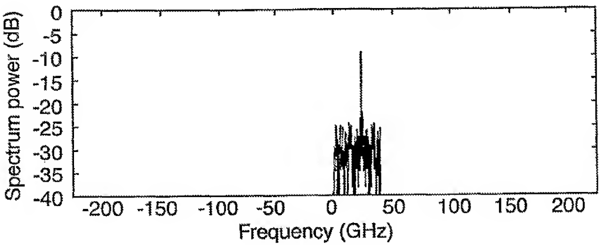
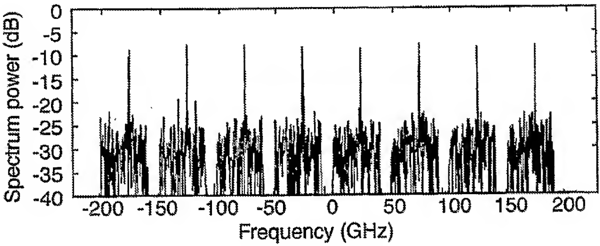


Figure 3d (reproduced below) illustrates the <u>spectral</u> profile for a series of WDM channels filtered using the filter 23 and having a channel spacing of 50 GHz, a spectral width of 40 GHz, and a separation between spectral widths of 10 Ghz.

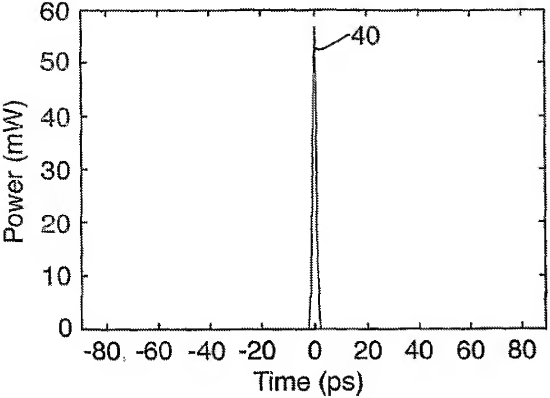
Fig.3d.



Note that each of Figures 3a through 3d represent spectral profiles, not temporal profiles. Figures 4a and 4b represent temporal profiles of the signal before and after filtering.

Figure 4a (reproduced below) illustrates the temporal profile of the signal before filtering as follows:

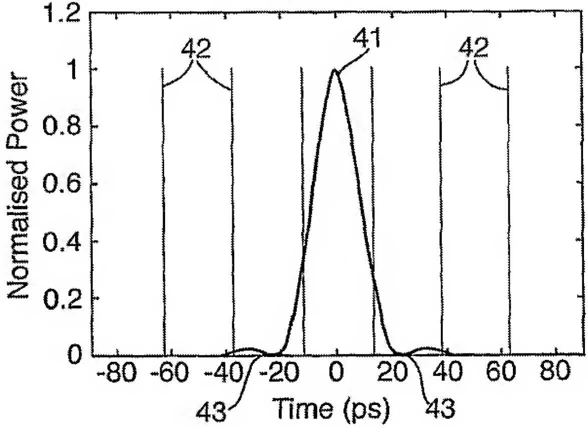
Fig.4a.



Note that the temporal profile of Figure 4a represents the same optical signal as the spectral profile of Figure 3a, despite their dramatic difference in appearance. If temporal and spectral profiles are interpreted to be the same, one would arrive at a completely erroneous understanding of the core nature of the optical signal prior to filtering.

Figure 4a (reproduced below) illustrates the temporal profile of the signal after filtering as follows:

Fig.4b.



Once again, note that the <u>temporal</u> profile of Figure 4b represents the same optical signal as the <u>spectral</u> profile of Figure 3c, despite their dramatic difference in appearance. If temporal and spectral profiles are interpreted to be the same, one would arrive at a completely erroneous understanding of the core nature of the optical signal after filtering.

Once again, referring to Figure 4b, claim 19 recites that "each carrier pulse [has] a substantially Sinc shaped <u>temporal</u> profile extending over more than one time slot, the substantially Sinc shaped <u>temporal</u> profile having a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse" (emphasis added).

In Figure 4b, the vertical lines show when each time slot begins and ends relative to the pulse shown. (*E.g.*, Specification at Page 4, lines 33-34). In the illustrated case, in which the bit

rate is 40 GHz, each time slot lasts 25 picoseconds (note: one picosecond is equal to 10^{-12} seconds). (*E.g.*, Specification at Page 4, lines 34 to Page 5, line 1). The pulse 41 extends over several time slots and the minima 43 of the filtered pulse falls in the center of the time slots adjacent to the time slop the pulse is centered on. (*E.g.*, Specification at Page 5, lines 1-4). The result is that the effect of the temporal overlap with neighboring bits or pulses is reduced. (*E.g.*, Specification at Page 5, lines 4-5). The pulse is also substantially sinc shaped. (*E.g.*, Specification at Page 5, lines 6-13).

The transmitter produces a signal with a narrow spectral width in which the pulse in the time domain overlaps several time slots without significantly adversely impacting neighboring pulses. Thus, narrow spectral pulses are achieved without significant patterning effects in the time domain.

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Did the Examiner err in rejecting claims 1, 3, 5-7, 13, 14 and 18-21 under 35 U.S.C. § 102(e) as being anticipated by Bulow (U.S. Pat. Pub. No. US2003/0165341)?

2. Did the Examiner err in rejecting claims 10-12, 15-17 and 22-24 under 35 U.S.C. § 103(a) as being unpatentable over Bulow (U.S. Pat. Pub. No. US2003/0165341) in view of Jacobowitz (U.S. Pat. No. 6,654,152 B2)?

ARGUMENT

I. Introduction

The Examiner has failed to establish a prima facie case of anticipation or obviousness for any of the pending claims 1, 3, 5-7, and 10-24 because the combination of references relied on by the Examiner does not disclose a filter that gives rise to carrier pulses having a temporal profile with a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse, the temporal profile of the corresponding carrier pulse further having an oscillating tail that extends from the minimum into at least one time slot that is even further from the time slot for the corresponding carrier pulse. The combination of references further does not disclose a filter that has a spectral profile giving rise to carrier pulses, each carrier pulse having a substantially Sinc shaped temporal profile extending over more than one time slot, the substantially Sinc shaped temporal profile having a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse.

II. Rejection Of Claims 1, 3, 5-7, 13, 14 and 18-21 under 35 U.S.C. § 102(e) as being anticipated by Bulow

A. ***Claims 1, 3, 5 and 13***

Claims 1, 3, 5 and 13 stand rejected under 35 U.S.C. §102(e) as being anticipated by United States patent application publication number US2003/0165341 issued to Henning Bulow (the patent application publication herein also referred to simply as "Bulow"). Of these claims, claim 1 is independent.

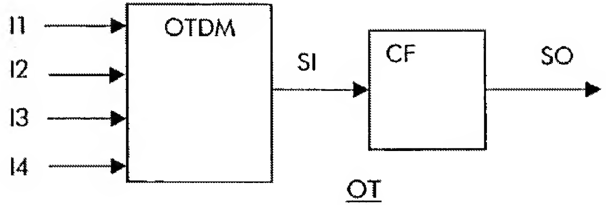
Claim 1 is an independent claim that recites a method of optically encoding data for transmission over a wavelength division multiplexed optical communications system. The method includes the generating of a periodic series of optical pulses defining a series of time slots, wherein one pulse appears in each time slot, the filtering of the pulses by way of a filter to

produce carrier pulses extending over more than one time slot, the modulating of the pulses with data for transmission.

Claim 1 recites specific parameters for the filtering. Specifically, for at least some of the carrier pulses, the filter gives rise to the corresponding carrier pulse having a <u>temporal</u> profile with a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse, the <u>temporal</u> profile of the corresponding carrier pulse further having an oscillating tail that extends from the minimum into at least one time slot that is even further from the time slot for the corresponding carrier pulse.

The Office Action mailed July 23, 2009 (hereinafter "the Office Action) alleges that the element labeled "CF" in Bulow teaches the recited filter of Claim 1. As will be explained, the rejection is based on a faulty interpretation of the functionality of the element "CF" in Bulow.

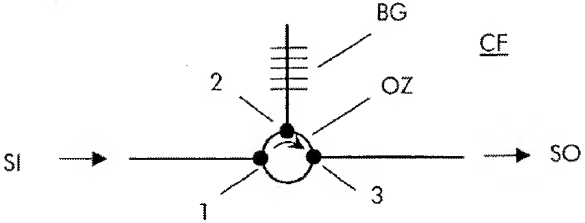
Figure 2a of Bulow illustrates a transmitter that includes the element "CF" as is reproduced below:



The "optical transmitter includes an optical time division multiplexing unit OTDM ... and a conversion filter CF" (Bulow, paragraph 24, lines 3-6). The OTDM outputs optical pulses at a particular bit rate modulated with data at that bit rate (see Bulow, paragraph 25). Importantly, Bulow teaches the following:

> The convention filter <u>broadens</u> the RZ like pulses of said time multiplexer output signal SI1 up to such a pulse width that pulses do not overlap into adjacent time windows or that only overlaps such, that time channel division at receivers side remains possible. (Bulow, paragraph 27, lines 3-7).

Thus, in Bulow, the CF merely broadens the input pulses, and does not seem to substantially change the form of the pulse. Figure 3 of Bulow is reproduced below and represents an example of the conversion filter CF of Figure 2A.

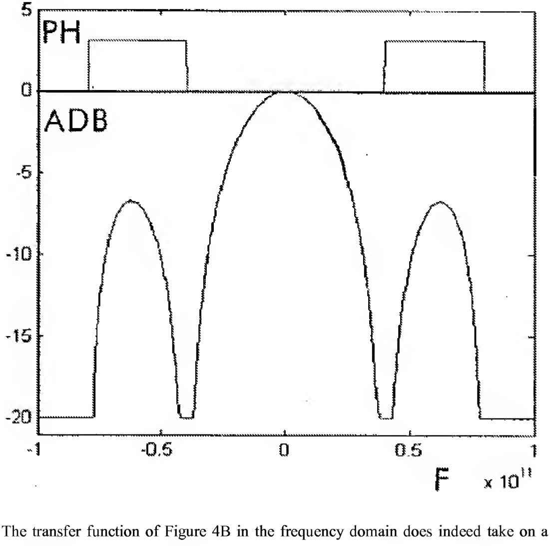


It is not necessary to guess at the functionality of the conversion filter CF. Figure 4A through 4C of Bulow illustrate specific functionality of the conversion filter CF. If the conversion filter CF does not act as the recited filter does, then the anticipation rejection should be withdrawn. Proper interpretation of Figures 4A through 4C of Bulow is not possible unless one properly distinguishes between a temporal profile and a spectral profile. Proper interpretation is also not possible unless properly distinguishing between a pulse diagram and an eye diagram.

The Office Action falsely asserts that Bulow teaches that the filter CF of Bulow gives rise to a corresponding carrier pulse that having a temporal profile with a minimum substantially in the center of the time slots adjacent to the tie slot for that corresponding time pulse. Specifically, the Office Action asserts that this conclusion is justified "as a result of the filter having a sinc

transfer function". The Office Action then references paragraph 0039 of Bulow as allegedly supporting this conclusion. The Final Office Action then further states that it is inherent in a filter having a sinc transfer function that the carrier pulse further has an oscillating tail that extends from the minimum into at least one time slot that is even further from the time slot for the corresponding carrier pulse (see top of page 3 of the Office Action).

Paragraph 0039 describes Figure 4B, which figure is reproduced below as follows:



The transfer function of Figure 4B in the frequency domain does indeed take on a very rough resemblance to a sinc function. It is critical to recognize that Figure 4B is a spectral diagram (with frequency, not time, plotted on the horizontal axis). If one lacks a recognition of this one

fundamental fact, one may completely misinterpret the nature of the optical signal. Recall that in the above Summary of the Claimed Subject Matter section, the undersigned clearly points out that the nature of the optical signal going into the filter 23 (of Figure 2 of applicants specification) may be completely misunderstood if one does not take into consideration that Figures 3a and 4a (of applicants' specification) represent the same signal, but the former is a spectral profile, while the latter is a temporal profile. Likewise, the nature of the optical signal exiting the filter 23 (of Figure 2 of applicants specification) may be completely misunderstood if one does not take into consideration that Figures 3c and 4b (of applicants' specification) represent the same signal, but the former is a spectral profile, while the latter is a temporal profile.

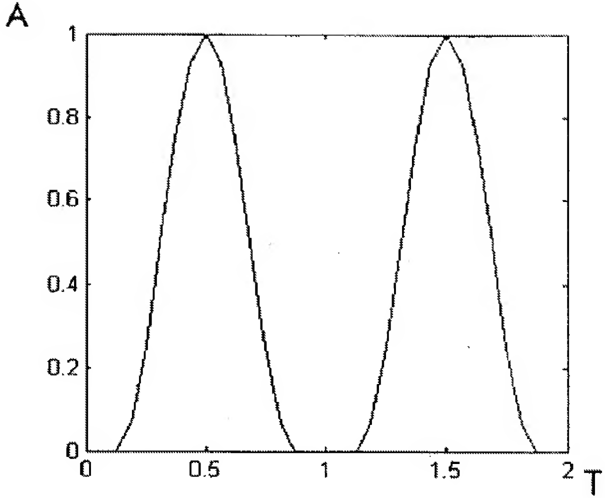
To note the importance of recognizing the difference between a spectral profile and a temporal profile, recognize that a sinc function in the frequency domain is a rectangular impulse in the time domain. Paragraph 0039 of Bulow even repeats this well recognized principle of signal theory by stating as follows:

> The transfer function partly and approximately shows a so-called si-function (si(x)=sin(x)/x) form. **In the time domain, the si-function represents a rectangular impulse**. (Bulow, paragraph 0039, emphasis added)

Thus, while the Examiner speculates that the filter described in 0039 implicitly results in a sinc-shaped pulse in the time domain, Bulow is clear that it does not. Rather, Bulow is clear that the filter has a sinc function only in the frequency domain, and thus would have a rectangular impulse response in the time domain. This rectangular impulse response only results in "narrow pulses of an input signal SI [being] broadened in the output signal" (Bulow, paragraph 0039, emphasis added), which is exactly what one would expect from a filter that

represents a rectangular impulse in the time domain. Specifically, the input pulse would remain the same shape, but simply be narrowed or, in the case of paragraph 0039, broadened. Thus, by confusing a sinc function in the time domain with a sinc function in the frequency domain, the Examiner is led to a clearly false conclusion regarding what Bulow teaches.

However, paragraph 0039 is not the only support for the fact that the filter CF does not produce an oscillating pulse as recited. After all, "FIG. 4c shows an eye diagram of an output signal SO of the conversion filter CF described under FIG. 4b, fed by a signal described under FIG. 4a" (Bulow, paragraph 0040, first sentence). Figure 4a is reproduced below and shows the pulses leading into the filter as follows:



Note that Figure 4a is an eye diagram, and not a pulse diagram (see Bulow, paragraph 0038, lines 1-3). An eye diagram is constructed by superimposing pulses resulting from a pseudo-random bit sequence. Although the pulses would be in different time slots, for purposes of analysis, they are superimposed to appear in the same time slot in an eye diagram. Accordingly, since the pulses are generated by a pseudo-random bit sequence, the eye diagram will superimpose low to low transitions, low to high transitions, high to high transitions, and high to low transitions. Although an eye diagram is different than a pulse diagram, the pulse may still be derived by ignoring the lines that represent high to high transitions, and low to low transitions, and watching only the lines that represent a low to high transition, followed by a high to low transition.

For instance, in Figure 4A, a high to high transition between the time window of minus one to zero, will simply be a horizontal line at amplitude 1 leading from time 0 to 0.5. Such a line will not be distinguishable from the upper boundary of the diagram since the upper boundary is also horizontal, and at an amplitude of unity. Likewise, a high to high transition between the time window of zero to one will also be represented by a horizontal line leading from time 0.5 to 1.5.

In Figure 4A, a low to low transition between the time window of minus one and zero, will simply be a horizontal line at amplitude 0 leading from time 0 to 0.5. Such a line will not be distinguishable from the lower boundary of the diagram since the lower boundary is also horizontal, and at an amplitude of zero. Likewise, a low to low transition between the time window of zero to one will also be represented by a horizontal line leading from time 0.5 to 1.5. Thus, the shape of the pulse may only be derived by following a low to high transition and a subsequent high to low transition. Thus, the pulse corresponding to the eye diagram of Figure 4A will appear as follows:

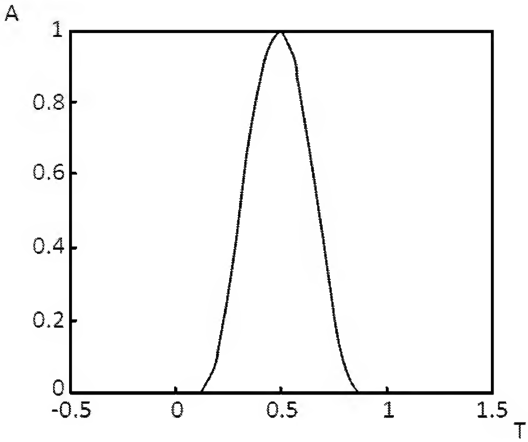
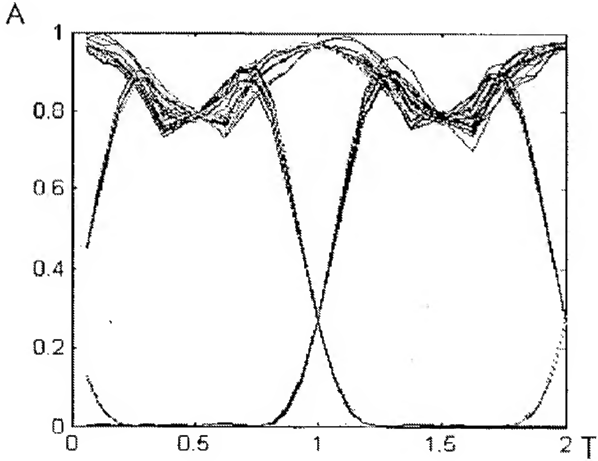
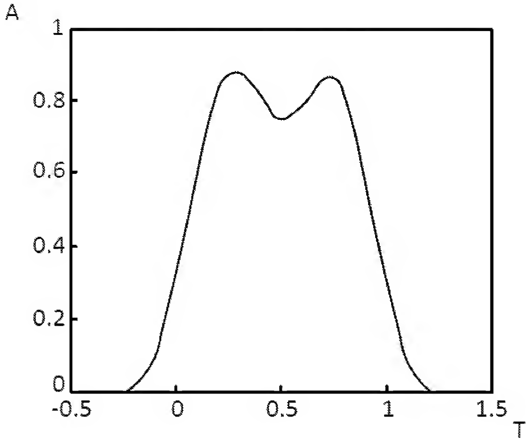


Figure 4C is also an eye diagram (see Bulow, paragraph 0040, lines 1-3), and is inserted below for reference:



Here, however, the high to high transitions are not longer congruent with the upper boundary of the eye diagram. Accordingly, the high to high transitions can be more readily observed. Likewise, the low to low transitions are no longer congruent with the lower boundary of the eye diagram. Accordingly, the low to low transitions can be more readily observed. Note that the superimposition of multiple pulses becomes more clear here since there are clearly a number of trace lines. Based on prior telephonic interviews, it appears to be these low to low transitions and the high to high transitions that seem to be leading the Examiner to erroneous conclusions regarding the shape of the actual pulse. The pulse shape corresponding to the eye diagram is not obtained by observing the high to high transitions or the low to low transitions in

an eye diagram. Rather, once again, one looks at a low to high transition followed by a high to low transition. Doing so, one obtains a pulse shape as shows as follows:



Throughout the prosecution history, the Examiner mistakes an eye diagram for a pulse diagram, and renders rejections based on that misunderstanding. The Examiner has argued in oral conferences that the recited oscillating tail of the claims equates to the oscillating lines that occur between amplitude 0.8 and 1.0 in Figure 4c. However, here the Examiner demonstrates a misunderstanding of the nature of an eye diagram, and seems to reject the claim based on that misunderstanding. One skilled in the art would not look towards Figure 4C directly, but would infer the pulse shape illustrated immediately above.

An eye diagram is constructed by superimposing pulses resulting from a pseudo-random bit sequence. Although the pulses would be in different time slots, for purposes of analysis, they

are superimposed to appear in the same time slot in an eye diagram. Accordingly, since the pulses are generated by a pseudo-random bit sequence, the eye diagram will superimpose low to low transitions, low to high transitions, high to high transitions, and high to low transitions. The asserted "oscillating tail" is simply a pulse transition from a high signal to a high signal. It does not represent the shape of the pulse. The claims recite a specific oscillating tail that relates to a specific pulse, not to a general eye diagram.

Although Figure 4C is an eye diagram, Figure 4C can be used to derive the general shape of a pulse if one knows how to interpret an eye diagram. Specifically, in Figure 4C, there are two distinct forms of a pulse that can be derived, one between times 0 and 1, and one between times 1 and 2. The pulses appear similar to each other. They are substantially broadened versions of the pulses shown in Figure 4A. There is some change in shape (notice the dip in the center of the high state). However, this is probably due to the sinc transfer function of Figure 4b not being an exact sinc function, but only a rough approximation. There is no sinc function shown present in the time domain with respect to any of these pulses.

As for the pulse corresponding to the time slot between time 0 and time 1, one can assume that the pulse is zero before some time point (probably about time minus 0.2 if the pulse can be assumed to take the same form as the pulse corresponding to the time slot between time 1 and 2). From that point moving forward, the pulse would rise gradually until time 0, when the pulse is within the field of view for Figure 4C. At time 0, the pulse has an amplitude of approximately 0.3. At about time 0.3, the pulse is maximized at approximately amplitude 0.9, whereupon it dips somewhat so that at time 0.5, the pulse has an amplitude of approximately 0.8. Being roughly symmetrical about time 0.5, at that point the pulse rises slightly to again attain approximate amplitude 0.9 at approximate time 0.7. Then the pulse consistently declines to

approximate amplitude 0.3 at approximate time 1.0. The pulse extends slightly into the next time slot, but declines to approximate amplitude 0 at time 1.2. The pulse between time 1 and time 2 could be described in the same way, except with all references times moving forward by one time slot.

The pulse understood from a proper interpretation of Figure 4C cannot lead to a conclusion that Bulow teaches the recited temporal profile of any of the independent claims. First, there is no minimum substantially in the center of the adjacent time slot. For instance, in Figure 4C, the pulse corresponding to the time slot between time 0 and time 1, does not reach a minimum at time 1.5. Even if it was interpreted to be so, there is no recited oscillating tail. The pulse corresponding to time slot 0 to 1, for example, does not show an oscillating tail that leads from time 1.5 further beyond time 2.0. Rather, the pulses corresponding to time slot 0 to 1 has a zero value in this range at time 1.5 and higher. One should not mistake the slight decline in

Accordingly, the rejections of the independent claims are based on clear errors of fact based on 1) a confusion between time domain and frequency domain, and 2) a misinterpretation of an eye diagram. The combination of these clear errors led to a rejection of the independent claims that is not supportable under any reasonable interpretation of Bulow.

Claims 3, 5 and 13 depend from Claim 1, and are thus not anticipated by Bulow for at least the reasons provided for Claim 1.

B. Claims 6, 7, 14 and 18

Claims 6, 7, 14 and 18 stand rejected under 35 U.S.C. §102(e) as being anticipated by Bulow. Of these claims, claim 6 is independent. Claim 6 is an independent claim that recites a transmitter for producing an optical data signal for transmission over a wavelength division multiplexer optical communication system. The transmitter includes means for producing a periodic series of optical pulses defining a series of time slots (one pulse appearing) in each time

slot, modulating means for modulating the pulses with data for transmission, and a filter having a spectral profile giving rise to carrier pulses.

Claim 6 also recites that each carrier pulse has a temporal profile extending over more than one time slot, the temporal profile having a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse, the temporal profile of the corresponding carrier pulse further having an oscillating tail that extends from the minimum into at least one time slot that is even further from the time slot for the corresponding carrier pulse. In this sense, claim 6 is similar to claim 1. Accordingly, since the element CF of Bulow does not equate to the recited filter, for the same reasons as described for claim 1, Bulow cannot anticipate claim 6 either. Claims 7, 14 and 18 depend from Claim 6, and are thus not anticipated by Bulow for at least the reasons that claim 6 is not anticipated by Bulow.

C. <u>Claims 19-21</u>

Claims 19-21 stand rejected under 35 U.S.C. §102(e) as being anticipated by Bulow. Of these claims, claim 19 is independent. Claim 6 is an independent claim that recites a transmitter for producing an optical data signal for transmission over a wavelength division multiplexer optical communication system. The transmitter includes means for producing a periodic series of optical pulses defining a series of time slots (one pulse appearing in each time slot), modulating means for modulating the pulses with data for transmission, and a filter having a spectral profile giving rise to carrier pulses.

Claim 19 recites that the filter has a substantially Sinc shaped <u>temporal</u> profile extending over more than one time slot, the substantially Sinc shaped temporal profile having a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse. Note that the filter is not recited as having a substantially Sinc shaped <u>spectral</u> profile. As noted in paragraph 0039 of Bulow, a filter with a sinc-shaped

spectral profile (see Figure 4B) will have a rectangular shaped temporal profile. Thus, the primary effect is simply to broaden the input signal. Another other effects will be due to imperfections in the sinc-shape in the spectral profile. As noted above in the pulse diagram corresponding to the eye diagram of Figure 4C, the pulse does not have a substantially sinc-shaped temporal profile with a minimum in the center of each time of the time slots adjacent to the time slot for the corresponding carrier pulse.

Accordingly, since the element CF of Bulow does not equate to the recited filter, Bulow does not anticipate claim 19 either. Claims 20 and 21 depend from Claim 19, and are thus not anticipated by Bulow for at least the reasons that claim 19 is not anticipated by Bulow.

III. Rejection Of Claims 10-12, 15-17 and 22-24 Under 35 U.S.C. § 103(a) As Being UnPatentable Over Bulow In View of Jacobowitz

A. ***Claim 10-12***

The Examiner rejected claims 10-12 under 35 U.S.C. § 103(a) as being unpatentable over Bulow in view of United States patent number 6,654,152 issued to Jacobowitz et al. (the patent hereinafter referred to as simply "Jacobowitz"). Claims 10-12 each depend directly from claim 1. As explained above with respect to claim 1, Bulow fails to teach or suggest the recited filter of Claim 1. Jacobowitz also does not teach or suggest such a filter, and the Examiner does not allege that Jacobowitz teaches such a filter. Accordingly, claims 10-12 are not unpatentable over the combination of Bulow and Jacobowitz.

B. ***Claim 15-17***

The Examiner rejected claims 15-17 under 35 U.S.C. § 103(a) as being unpatentable over Bulow in view of Jacobowitz. Claims 15-17 each depend from claim 6. As explained above with respect to claim 6, Bulow fails to teach or suggest the recited filter of Claim 6. Jacobowitz

also does not teach or suggest such a filter, and the Examiner does not allege that Jacobowitz teaches such a filter. Accordingly, claims 15-17 are not unpatentable over the combination of Bulow and Jacobowitz.

C. Claim 22-24

The Examiner rejected claims 22-24 under 35 U.S.C. § 103(a) as being unpatentable over Bulow in view of Jacobowitz. Claims 22-24 each depend from claim 19. As explained above with respect to claim 19, Bulow fails to teach or suggest the recited filter of Claim 19. Jacobowitz also does not teach or suggest such a filter, and the Examiner does not allege that Jacobowitz teaches such a filter. Accordingly, claims 22-24 are not unpatentable over the combination of Bulow and Jacobowitz.

III. Conclusion

For the foregoing reasons, Appellant respectfully requests the Board to overturn the Examiner's rejections of claims 1, 3, 5-7 and 10-24.

Dated this 19th day of May 2010.

Respectfully submitted,

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CLAIMS APPENDIX

1. (Previously Presented) A method of optically encoding data for transmission over a wavelength division multiplexed optical communications system comprising the steps of:

generating a periodic series of optical pulses defining a series of time slots, wherein one pulse appears in each time slot;

filtering the pulses by way of a filter to produce carrier pulses extending over more than one time slot; and

modulating the pulses with data for transmission; wherein

for each of at least some of the carrier pulses, the filter gives rise to the corresponding carrier pulse having a temporal profile with a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse, the temporal profile of the corresponding carrier pulse further having an oscillating tail that extends from the minimum into at least one time slot that is even further from the time slot for the corresponding carrier pulse.

2. (Cancelled).

3. (Previously Presented) A method according to claim 1, wherein the filtered carrier pulses each have a substantially flat top spectral profile.

4. (Cancelled).

5. (Previously Presented) A method according to claim 1, wherein the step of modulating the pulses with data is performed before the filtering step.

6. (Previously Presented) A transmitter for producing an optical data signal for transmission over a wavelength division multiplexer optical communication system comprising:

means for producing a periodic series of optical pulses defining a series of time slots, wherein one pulse appears in each time slot;

a filter having a spectral profile giving rise to carrier pulses, each carrier pulse having a temporal profile extending over more than one time slot, the temporal profile having a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse, the temporal profile of the corresponding carrier pulse further having an oscillating tail that extends from the minimum into at least one time slot that is even further from the time slot for the corresponding carrier pulse; and

modulating means for modulating the pulses with data for transmission.

7. (Previously Presented) A transmitter according to claim 6, wherein the filter has a substantially flat top spectral profile.

8-9. (Cancelled).

10. (Previously Presented) A method according to claim 1, wherein the filter is detuned to optimize transmission performance.

11. (Previously Presented) A method according to claim 1, wherein the filter is a super-Gaussian 6th order bandpass filter.

12. (Previously Presented) A method according to claim 1, wherein modulating the pulses with data for transmission is performed by a Mach Zehnder modulator.

13. (Previously Presented) A method according to claim 1, wherein a first portion of the oscillating tail rises as it extends from the minimum to a local maximum and a second portion of the oscillating tail falls from the local maxima as it crosses into the time slots adjacent to the time slots having the minimum.

14. (Previously Presented) A transmitter according to claim 6, wherein the modulating means is placed in the transmitter before the filter in a signal path of the transmitter.

15. (Previously Presented) A transmitter according to claim 14, wherein an amplifier is placed between the modulating means and the filter in the signal path of the transmitter.

16. (Previously Presented) A transmitter according to claim 6, wherein the modulating means a Mach Zehnder modulator.

17. (Previously Presented) A transmitter according to claim 6, wherein the filter is a super-Gaussian 6th order bandpass filter.

18. (Previously Presented) A transmitter according to claim 6, wherein a first portion of the oscillating tail rises as it extends from the minimum and a second portion of the oscillating tail falls in relation to the first portion as it crosses into the time slots adjacent to the time slots having the minimum.

19. (Previously Presented) A transmitter for producing an optical data signal for transmission over a wavelength division multiplexer optical communication system comprising:

means for producing a periodic series of optical pulses defining a series of time slots, wherein one pulse appears in each time slot;

a filter having a spectral profile giving rise to carrier pulses, each carrier pulse having a substantially Sinc shaped temporal profile extending over more than one time slot, the substantially Sinc shaped temporal profile having a minimum substantially in the center of each of the time slots adjacent to the time slot for that corresponding carrier pulse; and

modulating means for modulating the pulses with data for transmission.

20. (Previously Presented) A transmitter according to claim 19, wherein the substantially Sinc shaped temporal profile also has an oscillating tail that extends from the minimum to each of the time slots adjacent to the time slots having the minimum that are not the time slot for the corresponding carrier pulse.

21. (Previously Presented) A transmitter according to claim 20, wherein a first

portion of the oscillating tail rises as it extends from the minimum to a local maximum and a second portion of the oscillating tail falls from the local maxima as it crosses into the time slots adjacent to the time slots having the minimum.

22. (Previously Presented) A transmitter according to claim 19, wherein the filter is detuned to optimize transmission performance.

23. (Previously Presented) A transmitter according to claim 19, wherein the modulating means a Mach Zehnder modulator.

24. (Previously Presented) A transmitter according to claim 19, wherein the filter is a super-Gaussian 6^{th} order bandpass filter.

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

None.